SECTOR COMPETITIVENESS FRAMEWORKS

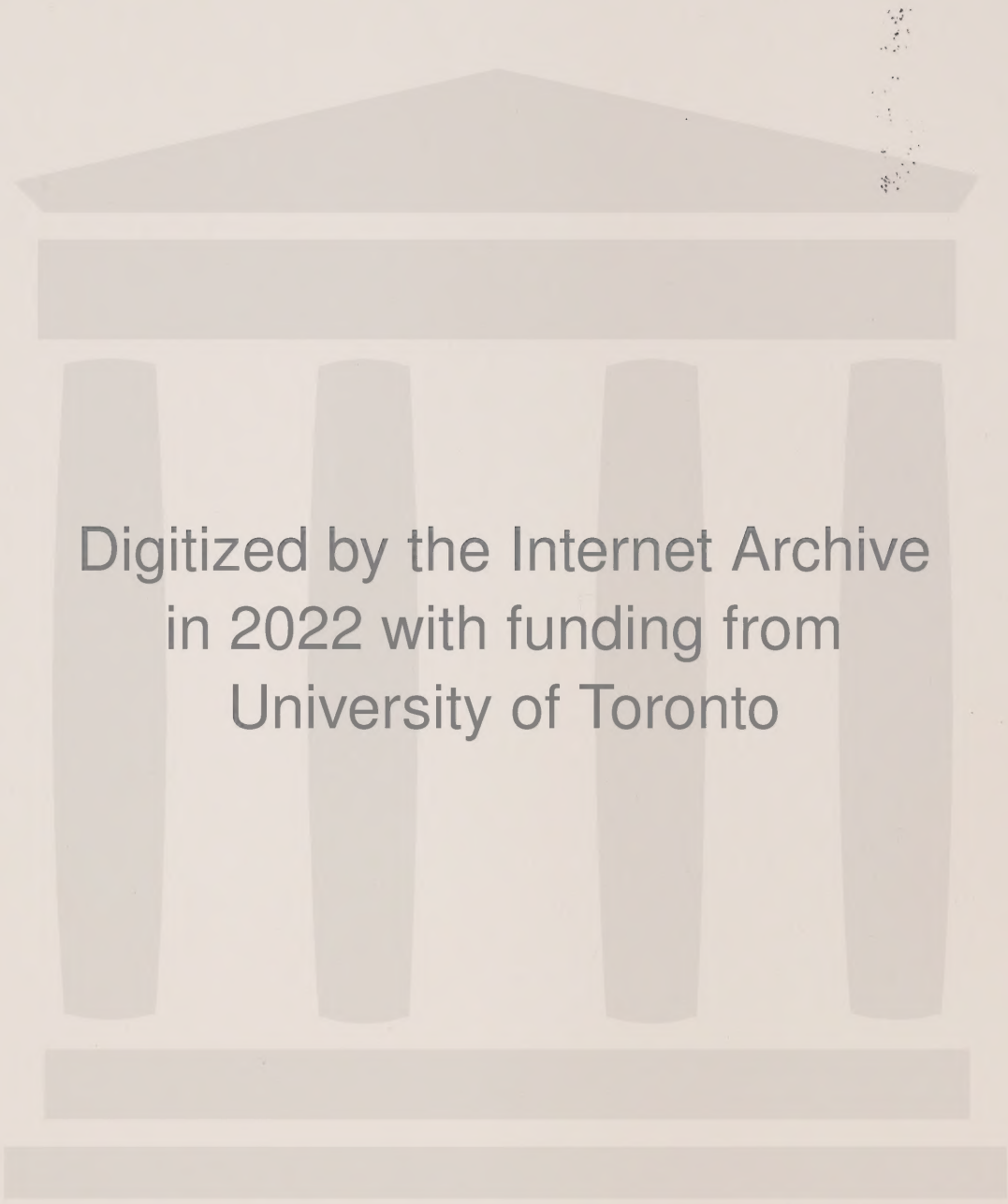
BUS MANUFACTURING

PART 1 – OVERVIEW AND PROSPECTS

Industry Sector
Transportation Industries

Secteur de l'industrie
Industries des transports

Canada



BUS MANUFACTURING

PART 1 – OVERVIEW AND PROSPECTS

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TRANSPORTATION
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This *Overview and Prospects* is the first of two companion documents on Bus Manufacturing in the **Sector Competitiveness Frameworks** series, which is being produced by Industry Canada in partnership with Canada's key stakeholders in the industry. *Part 2 — Framework for Action* will be prepared in coming months, based on consultations with major industry stakeholders, following study and review of the *Overview and Prospects*.

The **Sector Competitiveness Frameworks** series will focus on the opportunities, both domestic and international, as well as on the challenges facing each sector. The objective is to seek ways in which government and private industry together can strengthen Canada's competitiveness and, in doing so, generate jobs and growth.

In all, some 29 industrial sectors will be analyzed. *Part 1 — Overview and Prospects* will be available for distribution in printed as well as electronic forms during coming months for the following industries:

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FOREWORD

The new Canadian marketplace is expanding from national to global horizons and its economic base is shifting increasingly from resources to knowledge. These trends are causing Canadian industries to readjust their business approaches, and government must respond with new tools to help them adapt and innovate. Industry Canada is moving forward with strategic information products and services in support of this industry reorientation. The goal is to aid the private sector in what it is best qualified to do — create jobs and growth.

Sector Competitiveness Frameworks are a series of studies published by Industry Canada to provide more focussed, timely and relevant expertise about businesses and industries. They identify sectors or subsectors having potential for increased exports and other opportunities leading to jobs and growth. In 1996–97, they will cover 29 of Canada's key manufacturing and service sectors.

While they deal with "nuts and bolts" issues affecting individual sectors, the Sector Competitiveness Frameworks also provide comprehensive analyses of policy issues cutting across all sectors. These issues include investment and financing, trade and export strategies, technological innovation and adaptation, human resources, the environment and sustainable development. A thorough understanding of how to capitalize on these issues is essential for a dynamic, job-creating economy.

Both government and the private sector must develop and perfect the ability to address competitive challenges and respond to opportunities. The Sector Competitiveness Frameworks illustrate how government and industry can commit to mutually beneficial goals and actions.

The Sector Competitiveness Frameworks are being published sequentially in two parts. An initial *Overview and Prospects* document profiles each sector in turn, examining trends and prospects. The follow-up *Framework for Action* draws upon consultations and input arising from industry–government collaboration, and identifies immediate to medium-term steps that both can take to improve sectoral competitiveness.

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1 HIGHLIGHTS

The Canadian bus assembly and associated components manufacturing industry comprises nine major companies, most of which have plants in both Canada and the United States. There are two intercity, three urban transit and four major school bus manufacturers. Two companies are located in Manitoba, four in Quebec and three in Ontario. In contrast to the high-volume car assembly lines, buses are assembled by means of a sequenced workstation assembly process. The plants are generally low-volume assembly operations and are not highly automated. All three bus manufacturing subsectors in Canada are profitable, and the bus market is mature and stable.

The economies of bus manufacturing make every assembler very dependent on major independent systems suppliers who gain their economies of scale primarily from supplying the heavy truck manufacturing industry in North America and thus exert a high degree of influence over bus manufacturers. For example, system suppliers for the powertrain, driveline and steering are typically large companies whose sales to bus manufacturers represent only a small proportion of their total sales. The high-volume scale of systems components production and the degree of manufacturing specialization precludes backward integration by the bus manufacturer. Also, it is normal for the purchasers of buses, typically sophisticated fleet operators, to specify the major systems and components to ensure a product consistent with their fleet operating experience and maintenance practices.

Since 1965, qualified vehicle assemblers have operated under the duty-free trade provisions of the Canada–U.S. Automotive Products Agreement (Auto Pact). However, there remain financial incentives that bias bus purchasing decisions, such that the industry operates on only a partially rationalized basis in North America. Most noteworthy are "Buy America" regulations, which distort the market, as they require final assembly in the United States when U.S. federal funding is involved. Conversely, Canadian provincial governments also favour local assemblers. Despite this, the two countries form a single market, in which the Canadian-owned bus producers predominate.

Bus production in Canada exceeds domestic needs and exports are sold only in the United States. As a result, most of the Canadian bus manufacturing industry is strongly influenced by U.S. government policies, regulations and subsidies. Canadian bus manufacturers compete successfully in the North American bus market. They are most strongly represented in the intercity and urban transit bus manufacturing subsectors, where they are estimated to have about 70 percent of the North American bus market, and Canadian school bus manufacturers have about 11 percent of the North American market.

Since Canadian bus manufacturers meet most of Canada's domestic demand for intercity, urban transit and school buses, there is little opportunity for offshore import penetration. In fact, the North American market has few imports and exports, largely because of major design differences and performance

between offshore and North American buses. Barriers exist in differing technical requirements for intercity, urban and school buses and the strong presence of local content manufacturing rules further restricts the import of urban transit buses. Nevertheless, European bus imports have gained some market share in the North American intercity tour bus market segment.

In the urban and intercity bus manufacturing subsectors in North America, Canadian companies are the leaders in technology development and adaptation. They are excellent system integrators, innovative in body design and structure, and responsive to market demand. Several companies have redesigned their buses entirely to meet market needs and regulatory requirements, producing such innovative products as: articulated buses, low-floor buses, buses designed for the physically disabled and luxurious tour buses.

1.1 Major Trends

Evolution of the Market

An aging North American population and the growing demand for leisure travel, rather than scheduled service requirements, are expected to have a pronounced effect on the engineering design of future intercity buses. New intercity bus designs are oriented toward greater comfort and convenience of passengers as well as toward lower cost of operation. These new buses will also make extensive use of advanced materials to improve safety and reduce weight for improved economy of operation.

The most significant change in the urban bus market is the transition from high-floor (two or three steps up to floor height) to low-floor buses, where the floor is virtually at curb level. This transition has occurred much faster than anticipated, and it is estimated that 80 percent of all new buses put into service will be of low-floor design within two years. The remaining 20 percent will probably be conventional, of premium construction, more suited to operating on poorly maintained roads. This trend to low-floor bus models will be accompanied by the development of smaller buses (30 feet or 9.1 metres long, rather than the standard length of 40 feet or 12.2 metres) that will be designed to accommodate the changing market. New bus designs will feature extensive use of advanced materials as manufacturers try to increase the durability of their products, reduce weight in order to meet stricter emissions standards, as well as reduce total expenses over the life cycle of the vehicle.

Currently, engine manufacturers certify their products to U.S. Environmental Protection Agency performance standards, independently of the vehicle in which they are to be installed. If the anticipated transfer of responsibility for engine certification from the engine manufacturers to vehicle assemblers occurs, bus manufacturers will become fully responsible for the testing and certification of the finished vehicle. As well, more sophisticated life cycle cost management practices are also expected to have a major influence on the design of longer-lasting buses, especially as the market moves toward privatization, where

overall costs to operate are given a higher priority than in the current government-funded system of capital subsidies for public transportation vehicle procurement.

For the past few decades, the market for school buses was based on the social policy of bringing dispersed students to large centralized schools. No change in this policy is anticipated; therefore, the market will endure for school buses. Life cycle costing will become a major issue in this market as more and more school bus operations are privatized and school boards look for more efficient ways of transporting students. Because of declining public sector financing availability, the market is demanding that new school buses be designed for a longer operating life. Future school bus designs will have to include advanced materials for lighter, safer and more durable body structures. As well, declining public funding will require the consideration of other methods of transportation.

Financing Needs

Urban and school bus financing in the past has not been an issue, since all financing for the most part involved government funding of one form or another. School bus privatization has occurred in the past and will continue to grow as school boards search for more cost-effective ways of doing business. With the trend to lower government subsidies and even privatization, urban transit authorities or their equivalent private sector companies will have to look to innovative financing for new buses or change the social policies implicit in centralized

schools. Low life cycle costs and the availability of funding will become issues in the future for both urban and school bus operators. Private companies will look for the best available financing packages. This trend will change the way in which buses are bought and sold in the future.

Human Resources

The need to increase productivity and utilize advanced materials will place higher demands on the assembly plant work force and foster the development of new skills for the workers in all subsectors. Flexible manufacturing and team manufacturing will require additional training and the acquisition of new skills such as electronic control, advanced materials and quality control concerns. The upgrading of skills will require a well-planned and coordinated effort.

Sustainable Development

The "greening" of the transportation system in general and the public transportation system in particular represents a challenge to both bus manufacturers and regulators. The introduction of clean, advanced manufacturing processes will be a continuous effort. New buses will need to become "greener" in the drive for zero emissions by public transportation systems, and new systems technologies must prove to be both effective and affordable. New product technologies have been developed and could contribute substantially to the quest for zero emissions.

Trade

In the near future, the emerging markets of Central and South America could provide sales potential for Canadian buses and technologies. However, if the current trend toward a longer useful life for all buses prevails, then the overall market for new buses will decline. Longer-lasting bus models with extended warranties will be the main contributors, but there will be a concurrent increase in the demand for rebuilt buses and a consequent increase in demand for replacement parts and components.

1.2 The Bottom Line

Bus manufacturing in Canada currently is reasonably profitable and the market is stable. However, increasing price competition among intercity bus producers indicates a need to reduce production costs while increasing bus quality and customer satisfaction.

Substantial manufacturing overcapacity remains in the industry and further industry rationalization is likely. Furthermore, interprovincial barriers to bus purchases will continue to cause distortions in the market until 1998. The industry could benefit from a more rapid removal of these barriers.

Assembly plant jobs are expected to decrease due to further productivity improvements in the assembly process and as manufacturers outsource some parts-making and subassembly processes. New jobs are expected to be created in the independent supply sector as this occurs.

Canadian producers continue to lead in specialized areas such as the manufacture of low-floor buses, the use of alternate fuels, more efficient transmissions, innovative fuel cell technology and buses for the physically disabled. In addition to new bus technologies and composite materials, Canadian urban bus manufacturers are focussing greater research and development (R&D) efforts on improving quality and lowering production costs. Although no breakthroughs are on the horizon for school buses, a redesigned school bus with new materials and alternate fuel technology would meet a latent market demand.

2 KEY POINTS ABOUT THIS INDUSTRY

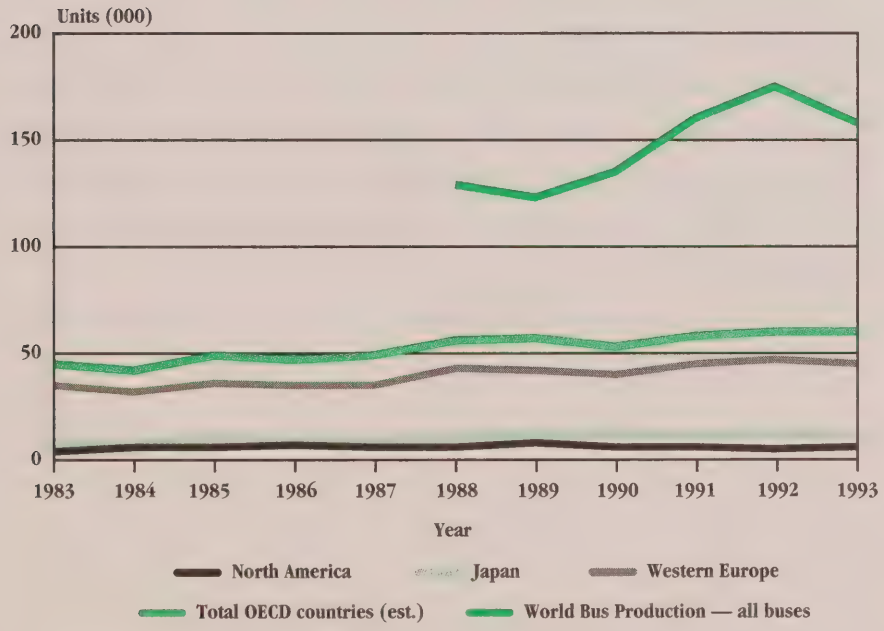
This *Overview and Prospects* for bus manufacturing reviews the key characteristics, changing conditions and future prospects of the Canadian bus assembly and associated components manufacturing industries, focussing on heavy buses used for intercity travel, tourism, urban mass transit and school system transportation. This industry is defined by Statistics Canada as Standard Industrial Classification (SIC) Codes 3231, Motor Vehicle Industry, complete vehicle assemblers and 3241, Truck and Bus Body Industry, bus body builders.

2.1 Global Context

A stable world market for buses is dominated by large truck manufacturers

While as many as 296 bus manufacturers in 71 countries produce an annual total of about 70 000 heavy buses (capable of carrying 30 passengers and over), a few large truck and bus producers dominate the global industry. In order of worldwide importance, these are: Mercedes-Benz (Germany), Volvo (Sweden), Isuzu (Japan), Scania (Sweden), Mitsubishi (Japan) and

Figure 1. Worldwide Production of Heavy Buses



Source: *Volvo Fact Book*, 1994.

MAN (Germany). These companies are integrated both horizontally, in the sense that they make heavy and in some cases light trucks, and vertically, in that they make systems and components and assemble these into completed vehicles.

Falling ridership reduces the North American market

While bus production has been increasing steadily in western Europe, it has been declining in North America, including Canada, because of falling ridership and reductions in public sector budgets for purchase of new equipment. On this continent, none of the large, integrated plants producing and assembling automobiles or heavy trucks also produce buses. There is little two-way trade in buses between North America and the rest of the world.

European bus manufacturers influence NA bus design

Nevertheless, several large European bus manufacturers operate in the United States, either through production facilities located there or through direct sales. Neoplan, Van Hool, Ikarus and Kässbohrer established subsidiaries and investments in the early 1980s. In addition, European bus designs influence North American manufacturers. Major Japanese bus and heavy vehicle manufacturers are virtually absent from the Canadian, U.S. and Mexican markets. However, Japanese and European bus producers are expanding rapidly in developing countries through subsidiaries and joint ventures.

Government funding and regulations influence production and sales

In every major market, government policy has an important impact on bus production and sales through technical standards regulation, environmental requirements, urban transit authority funding, school bus purchases, local product preference, intercity carrier regulations and special needs such as handicap access.

2.2 North American Context

NA bus production sells $2 billion and employs 15 000

Bus production in North America is an important industry with sales of over $2 billion and total employment of about 15 000 (Table 1).

Table 1. North American Market Size by Type of Bus (Units)

	1992	1993	1994	1995
Large transit buses	3 900	4 600	5 100	5 100
Intercity buses	1 000	1 100	1 100	1 200
School buses	27 000	29 800	30 000	30 000
Total: All buses	**31 900**	**35 500**	**36 200**	**36 300**

Source: Industry Canada estimates based on data supplied by various companies.

In 1995, about 36 300 units were sold, of which school buses accounted for an estimated 83 percent of the total. Transit buses, at 5100 units, formed about 14 percent. Lastly, new intercity coach sales of 1200 units comprised 3 percent of total sales. Overall, the estimates showed that the market was levelling off.

Six companies dominate NA intercity bus production . . .

Based on the more complete data for 1994, North America had four major intercity bus producers and two European bus producers, the latter having established manufacturing facilities and service operations in the United States. Total sales volume was 1500 units, generating $400 million in revenue. Some 2500 people were employed in production.

seven in transit . . .

Seven urban transit bus manufacturers with a combined annual volume of 2400 units employed about 3300 people and had estimated sales of $590 million.

six in school buses

Six major school bus producers and 11 smaller ones produced around 29 800 units, employed about 7600 people and generated sales of about $1.1 billion.

NA bus manufacturing is a mature, concentrated industry

Bus manufacturing in North America is mature, with substantial industry concentration. For example, in the intercity segment, one company, MCI, has more than 50 percent of the North American market share and, together with Volvo-Prévost, almost 70 percent of the total. The others, European bus producers Neoplan, Van Hool and Kässbohrer, share the rest of the market. In the urban transit bus segment, three Canadian-owned firms, Nova BUS, New Flyer and Orion, account for about 70 percent of the total North American market. The two largest firms producing school buses, Blue Bird and Thomas Built, together have about 55 percent of the North American market. Two others, AmTran and Carpenter Manufacturing, each have about 14 percent (Annex A lists major bus producers, their national ownership, products and nominal capacity).

NA bus manufacturers share independent systems suppliers with NA heavy truck assemblers

North American bus manufacturers are very dependent on major independent systems suppliers, whose primary focus is the North American heavy truck manufacturing industry and who have substantial market power over bus assemblers. Suppliers of powertrain, driveline and steering systems are typically large companies, and their sales to bus manufacturers form only a small proportion of their total output.

The high-volume requirements of systems production and the degree of manufacturing specialization preclude rearward integration by the bus manufacturers. Purchasers of buses, typically sophisticated fleet operators, frequently specify the major components to ensure a high-performance product.

2.3 Canadian Industry Snapshot

Canadian bus manufacturers are engaged in design and final assembly of transit, intercity and school buses. Generally, Canadian bus manufacturers use or inexpensively adapt major systems and components developed for higher-volume, heavy, over-the-road trucks or even higher-volume light commercial trucks. Proprietary designs of the bus manufacturers are limited to systems or parts that have no satisfactory counterpart to be taken from a high-volume, non-bus market. However, Canadian companies are innovative and capable of supplying a variety of product designs, including those for special purposes such as conveying the physically disabled.

Canadian firms adapt and innovate to meet special needs

In contrast to high-volume automotive assembly, buses are assembled by means of a sequenced workstation assembly process; plants are generally low-volume operations and are not highly automated. The major systems, such as the chassis parts, the engine, the transmission, steering, axles and brakes, which can represent up to 50 percent of the cost of a bus, are purchased from independent U.S. suppliers. A basic urban bus sells for about $250 000, an intercity bus about $350 000 and a school bus for about $50 000. Each can be customized at extra cost.

Buses are made by sequenced workstations, rather than automobile-type production lines

The Canadian bus manufacturing industry comprises nine major companies operating in both Canada and the United States. There are two intercity, three urban transit and four major school bus manufacturers. Annual bus production in Canada is about 10 000 units of all types. Many units are produced as shells in Canada and then finished in the United States.

Canada's two intercity, three urban transit and four school bus firms sell an average of $450 million each year

During the past seven years, shipments have ranged from a low of $360 million in 1993 to a high of $512 million in 1994. Bus manufacturing as a percentage of total automotive gross domestic product (GDP) has ranged from a low of 2.5 percent in 1993 to a high of 3.9 percent in 1990 (Table 2). As a percentage of total GDP, bus manufacturing has ranged between 0.05 percent and 0.07 percent during this period.

Table 2. Contribution of Bus Manufacturing to GDP, Canada

	1989	1990	1991	1992	1993	1994
Bus shipments ($ million)	407.0	491.6	455.4	453.8	360.0	511.7
■ as a share of automotive GDP (%)	2.98	3.95	3.83	4.26	2.48	3.78
■ as a share of total GDP (%)	0.06	0.07	0.07	0.06	0.05	0.06

Source: Industry Canada estimates based on data supplied by various companies.

Bus manufacturing contributes capital equipment and major refitting services to the transportation equipment manufacturing sector, which comprises 2.7 percent of GDP at factor cost. It also accounts for almost 21 percent of total manufacturing shipments and 15 percent of the manufacturing value-added by Canadian establishments. Within the transportation sector, buses are generally considered to be the "low-cost supplier" in competition with trains, planes and automobiles on intercity runs, and with automobiles on urban and commuter runs. Buses typically feed into guided urban mass transit systems in larger cities such as Montreal, Toronto, Vancouver and Edmonton.

Canadian bus production is centred in Ontario, Quebec and Manitoba

Two producers are located in Manitoba, four in Quebec and three in Ontario. Suppliers of parts, components and major systems are located mainly in Ontario, Quebec and Manitoba, as well as in the United States.

Industry Structure and Ownership

Two firms build intercity buses in Canada

Two Canadian intercity motor coach manufacturers, Motor Coach Industries Limited (MCI), in Winnipeg, Manitoba, and Volvo-Prévost Car Incorporated, in Sainte-Claire, Quebec, specialize in coaches produced for privately owned, long-distance line-haul, charter and tour-bus operations such as Voyageur, Gray Coach and Greyhound. In addition, publicly funded transit operators purchase some highway coaches for their commuter services. Intercity motor coach manufacturers primarily build 40- and 45-foot (12.2 and 13.7 metres) coaches and some articulated 60-foot (18.3 metres) models.

MCI, which was purchased by the Mexican company Dina in 1994, has plants in Winnipeg, Manitoba, and Pembina, North Dakota. The Manitoba plant makes coach shells valued at about 40 percent of the completely equipped bus. At full capacity, it can produce over 1100 coach shells annually, using one shift. The shells are then shipped to the Pembina plant for final assembly and trim. Some completed vehicles are returned for sale in Canada. Volvo-Prévost manufactures only in Canada and has the capacity to produce about 500 coaches annually, using one shift. Virtually all of its final assembly is done in Canada.

Three major firms produce urban transit buses

Major urban transit bus manufacturers include New Flyer Industries Limited in Winnipeg, Manitoba; Orion Bus Industries Inc. in Mississauga, Ontario; and Nova BUS Corporation in Saint-Eustache, Quebec. These produce 35- and 40-foot (10.6 and 12.2 metres) conventional buses, 60-foot (18.3 metres) articulated buses, electric trolley buses and low-floor buses.

These manufacturers serve primarily the needs of municipal transit authorities and other publicly funded transit operators in both Canada and the United States. Canadian companies are capable of supplying a variety of product designs, including those for special purposes such as conveying the physically disabled.

New Flyer has plants in Winnipeg, Manitoba, and in Crookston, Minnesota, for final assembly. The company has a production capacity of 600 units per year. Orion, owned by Western Star Trucks of Kelowna, British Columbia, has a manufacturing plant in Mississauga, Ontario, a final assembly plant in Oriskany, New York, and is currently constructing a new plant in Mississauga. The firm can produce 1400 units a year. Nova BUS operates manufacturing plants in Saint-Eustache, Quebec, and two acquired by purchasing a competitor, TMC, in Roswell, New Mexico, and Schenectady, New York. It has a production capacity of 1200 units in each of its Canadian and U.S. plants.

U.S. competitors of Canadian producers are Flxible, Ikarus, Gillig and Neoplan. During the 1980s, there was a dramatic shift in the position of the transit bus companies in the North American market. In the early 1980s, GM dominated with a more than 50 percent share. Now, Flxible, Neoplan and Nova BUS-TMC each have about a 25-percent share of the North American market. Orion's market share has risen to about 10 percent since its inception in 1985, and New Flyer's market share is about 9 percent.

In the mid-1980s, nine European manufacturers entered the North American market, most opening U.S. plants to meet the U.S. federal government's "Buy America" legislation. (This requires, in addition to final assembly in the U.S., a 60-percent minimum domestic U.S. content.) However, strong competition and a soft market have since forced four European companies to close their plants.

Four school bus manufacturers

There are two Canadian-owned school bus manufacturers — A. Girardin Incorporated in Drummondville, Quebec, and Les Entreprises Michel Corbeil Inc. in Ville des Laurentides, Quebec — and two American-owned companies — Canadian Blue Bird Coach Limited in Brantford, Ontario, and

Thomas Built Buses of Canada Limited in Woodstock, Ontario. These firms also make buses for use in small and mid-sized transit and shuttle bus service applications. Conventional school buses account for 80 percent of North American sales by unit, with only 20 percent of total production in the form of transit and shuttle buses.

Blue Bird is the leading manufacturer in the North American school bus market and distributes its products continent-wide. In Canada, Blue Bird manufactures conventional bus bodies in 27-, 29- and 37-foot (8.2, 8.4 and 11.2 metres) lengths and also produces flat-nosed buses as well as some parts. Thomas Built Buses makes bus bodies and places them on its own chassis as well as those manufactured by GMC, Ford and Navistar. While it produces four distinct school bus designs in several lengths, only conventional, full-sized and small buses are produced in Canada; flat-nosed models are typically imported from the United States.

The Canadian producer A. Girardin manufactures school minibuses to seat up to 20 passengers. Bodies are made by the company and placed on rear-wheel-drive van chassis mainly supplied by Ford, GMC or Navistar. The company also produces vehicles to transport disabled persons. Les Entreprises Michel Corbeil Inc. manufactures standard school buses, school minibuses and vehicles for transporting physically disabled people as well.

Canadian school bus manufacturers fill a niche in smaller school buses and specialized buses

The industry is represented by the Canadian Urban Transit Association (CUTA), the Ontario Motor Coach Association, the Canadian Bus Association and the Quebec Bus Owners Association.

Bus manufacturing employs over 3000 people . . .

more than half make intercity buses, a third urban transit, a sixth school buses

Human Resources

The Canadian bus manufacturing industry labour force is generally composed of mechanics, assemblers and maintenance staff. Employment in the bus manufacturing industry has varied from a low of 2850 in 1993 to a peak of almost 3150 workers in 1994. They are distributed as follows: approximately 51 percent in the intercity coach subsector, 32 percent in the urban transit subsector and 17 percent in the school bus subsector (Table 3). In 1994, bus manufacturing industry employment was 2.6 percent of total automotive employment in Canada, and 0.2 percent of Canada's manufacturing employment. Plant employment has fluctuated over the years.

Table 3. Employment in Bus Manufacturing Plants, Canada

	1990	1991	1992	1993	1994
Intercity	1 600	1 600	1 550	1 600	1 650
Urban	1 000	1 000	1 100	750	1 000
School	500	500	430	500	550
Total	**3 100**	**3 100**	**3 080**	**2 850**	**3 150**

Source: Industry Canada estimates based on data supplied by various companies.

The need to increase productivity and utilize advanced materials will place higher demands on the assembly plant work force and foster the development of new skills for the workers in all subsectors. Flexible manufacturing and team manufacturing will require additional training and the acquisition of new skills such as electronic control, advanced materials and quality control.

Technology

Canadian bus manufacturers have historically been dependent on American product development, to the mutual benefit of both countries. Engines, transmissions and axles for buses have typically been designed by American companies. Historically, bus designs have been developed by American companies and then produced in Canada under licence or by a Canadian subsidiary. Some best-selling designs have also been developed jointly.

After years of dependence on the U.S. for product development . . .

In the urban and intercity bus manufacturing subsectors in North America, Canadian companies are the leaders in technology development and adaptation. They are excellent system integrators, innovative in body design and structure, and responsive to market demand. Several companies have redesigned their buses entirely to meet market needs and regulatory requirements, producing such innovative products as articulated buses, low-floor buses, buses designed for the physically disabled and luxurious tour buses.

Today, the trend is to develop innovative bus designs in Canada, for example, at Orion Bus Industries, New Flyer Industries and Nova BUS. However, it is not feasible to finance the creation of significant new designs or components just for the Canadian market. Without the capacity to export, the Canadian transit industry would have very limited capacity to invest in research and development (R&D) for new products, such as lightweight buses, new propulsion technology, new fare systems, etc.

. . . trend in Canada is toward innovative bus design

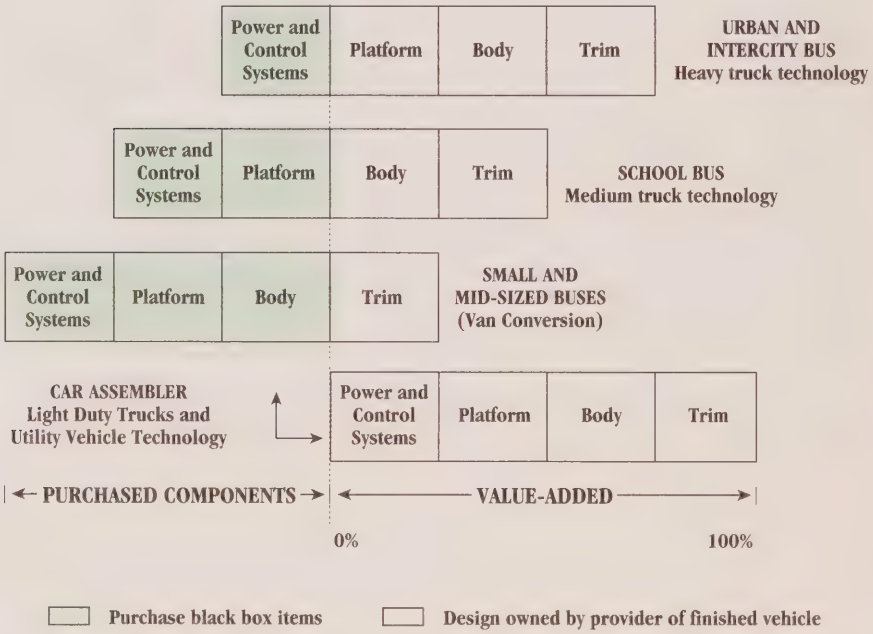
Research and Development

In the bus industry, proprietary design is limited to specific parts

Intercity Buses

Generally, bus manufacturers use or adapt major systems developed for the much-higher-volume production of trucks. Proprietary designs of bus manufacturers are limited to systems or parts where there is no satisfactory counterpart to be taken from a high-volume market for vehicles other than buses. This gives urban and intercity bus manufacturers proprietary control over only the bus platform, the bus body and the trim; they purchase the power and control systems. School bus manufacturers have even less control, being restricted to bus body and trim, and they purchase the major systems and the chassis. Each type of bus manufacturer has particular proprietary domains (Figure 2).

Figure 2. Categories of Proprietary Technology by Type of Bus Producer



R&D expenditures generally precede the introduction of new models, beginning several years before actual introduction to develop, test and prototype new models. The three bus subsectors in Canada operate in a distinct manner but still use R&D prior to the introduction of new models or as a consequence of upgraded standards or regulations.

Canadian intercity and urban bus manufacturers spend heavily on R&D . . .

Both intercity coach and urban bus manufacturers in Canada have substantial R&D activity. Urban bus manufacturers made major expenditures during the late 1980s and early 1990s as they began development work on new low-floor designs to meet the needs of both an aging population and handicapped persons. Similar R&D expenses occurred in intercity motorcoach manufacturing as companies introduced more luxurious, passenger-oriented designs.

. . . whereas Canadian school bus manufacturers rely more on U.S. R&D

School bus operations in Canada have low R&D expenditures, since almost all product development is done at head offices in the United States or at the engineering offices of chassis suppliers. Moreover, school bus R&D activity in Canada is mainly related to plant design and manufacturing process changes. None of the three bus manufacturing subsectors undertakes drivetrain development or incur the associated R&D expenditures. The latter is the responsibility of such major component suppliers as Rockwell, Allison, ZF, Detroit Diesel and Cummins.

In many cases, costs associated with major component development can exceed costs of developing the vehicle in which the components are to be used. Therefore, R&D costs associated with the Canadian bus manufacturing industry appear to be low relative to those in the automotive industry in general, where development costs are an integral part of the car manufacturer's R&D expenditures.

Government Policy

The federal government sets environmental and safety standards

Environment Canada sets the policy for vehicle emissions; vehicle emission standards and safety regulations are set and enforced by Transport Canada.

The provinces set in-use standards and regulations

All provinces set in-use standards and regulations. Historically, they have provided guidelines for preferential purchasing of local or Canadian content in their urban bus purchases. These procurement restrictions have recently been relaxed, and there is agreement among the provinces that the restrictions will be terminated by the end of 1998. However, provincial government subsidy programs still exist for the purchase and operation of public transit vehicles by regional and local authorities.

2.4 Trade

Canada exports 68% of bus production . . .

97% of which is to the U.S.

In 1994, Canadian exports of finished buses and shells approached 68 percent of total bus production and were worth about $349 million (Table 4). About 97 percent of exports went to the United States, which was reciprocally the main source of major components such as engines, transmissions and axles. Major systems have typically approached 50 percent of the cost of producing a bus.

Table 4. Shipments, Exports, Imports and Value-added of Bus Manufacturing, Canada

	1989	1990	1991	1992	1993	1994
Shipments ($ million)	407	492	455	454	360	512
less: Exports ($ million)	211	252	273	259	280	349
plus: Imports ($ million)	44	42	69	43	47	28
Domestic demand ($ million)	240	282	251	238	127	191
Trade balance ($ million)	167	210	204	216	233	321
Value-added ($ million)	154	215	215	160	197	277
Exports (% of shipments)	52	51	60	57	78	68
Imports (% of domestic demand)	18	15	27	18	37	15

Source: Industry Canada estimates based on data supplied by various companies.

Until 1977, bus production in Canada was primarily for the domestic market. School bus manufacturers supplied the Canadian market and some areas of the U.S.

The sale by New Flyer Industries of 343 trolley coaches to San Francisco, California, began a trend to exporting. New Flyer at the time was the sole manufacturer of trolley coaches in Canada and the U.S.

Today, Canadian bus manufacturers compete effectively in the North American bus production market and have won substantial market share. They are strongest in the intercity and urban transit bus manufacturing subsectors.

Since operating conditions, regulatory environment and customer requirements are very similar in Canada and the U.S., buses produced for both markets are very similar. Most importantly, they use the same major components and have frequently had a common historical engineering design. Major component and parts suppliers are located in the U.S. and supply a broad range of light and heavy vehicle assemblies. Few component manufacturing companies supply only bus manufacturers.

Canadian intercity and urban bus makers have 70% of NA market share

Canadian-based intercity and urban transit bus manufacturers are estimated to have about 70 percent of the entire North American bus market. MCI and Volvo-Prévost in particular depend heavily on exports to the U.S. As a result, most of the Canadian bus manufacturing industry is strongly influenced by U.S. government policies, regulations and subsidies.

There are virtually no imports to replace

Canada's urban transit market has little scope left for import replacement. Almost all of Canada's domestic demand for intercity and urban transit buses is provided by Canadian bus producers. Of the Canadian market for transit buses in 1994, Orion had about 11 percent, New Flyer 20 percent and Nova BUS 69 percent.

Canadian school bus makers have 11% of NA market

The Canadian school bus manufacturing subsector has about 11 percent of the North American market. In 1994, Thomas Built was estimated to have 38 percent of the Canadian market, and Blue Bird 45 percent. The remainder is shared between the other two producers.

Exports are tariff-free but non-tariff barriers remain

Canadian trade in buses and related components is governed under the 1965 Canada–U.S. Automotive Products Agreement (Auto Pact), the 1989 Canada–U.S. Free Trade Agreement (FTA) and the 1994 North American Free Trade Agreement (NAFTA) among Canada, the United States and Mexico. Bus components are duty-free, and the industry operates on a partially rationalized basis throughout North America. The ability to import components and to export buses free of duty considerably enhanced Canadian manufacturers' price competitiveness. However, barriers to freer North American trade still remain in differing technical requirements for intercity and school buses and in the presence of strong local content manufacturing rules for urban transit buses.

North American urban transit buses are generally not well suited to operating conditions in developing countries, being too expensive to purchase, too costly to operate and too technically sophisticated to maintain easily. Most developing countries prefer locally manufactured buses. Indigenous manufacturers are common and organize the production of bus bodies and standard school bus vehicle types, the latter often on a truck chassis.

2.5 Performance and Competitiveness

Employer-sponsored benefits cost 1% of gross pay in Canada . . . American companies pay 6.2%
— KPMG, *A Comparison of Business Costs in Canada and the United States, 1995*

Comparative data indicate that Canadian input costs are equivalent to those in the United States, with the exception of labour costs, which are higher in Canada. This is in contrast with the situation in the automotive sector, where Canada has a 24-percent labour cost advantage over the U.S. However, there is little product differentiation, real prices are declining and excess capacity exists in urban transit bus production, in particular.

As a result, the industry has consolidated through corporate divestitures, acquisitions, production facility rationalization, plant closures and company exits from the industry. Intense price competition has forced strict cost controls. Nevertheless, urban transit and intercity bus manufacturers — particularly Canadian companies — have made innovative products such as articulated buses, low-floor buses and buses designed for the disabled. Intercity motorcoach producers have also introduced new designs that originate in Canada.

Faced with overcapacity, the industry has consolidated and imposed strict cost controls

Canadian bus makers produce more than the Canadian market consumes and therefore depend heavily on U.S. exports. Several Canadian manufacturers have final assembly plants in the U.S. specifically to comply with both U.S. federal and state legislation. These facilities represent added manufacturing capacity and investment, complicate manufacturing processes, result in increased vehicle costs and represent a significant shift in economic value per vehicle to the U.S. location.

Canadian plants on U.S. soil provide market access

In fact, the North American market has few imports and exports, largely because of major design differences, width and performance between offshore and North American buses. Each geographic location has its own use cycle and unique safety standards, which significantly affect design.

No interchangeability with European bus products

Consequently, North American bus manufacturers export very few products and have had very little foreign competition. European bus imports have gained a niche market share in intercity tour buses because of their unique designs. In 1994, this was less than 1 percent of the North American market.

Greyhound Corporation's sale of Greyhound Lines and its subsequent financial difficulties as well as the purchase of MCI by Dina ended the once-dominant intercity pattern linking bus manufacture to transportation management. Overall, the shift appears to have been away from forward integration, including transportation service, to what might be termed "horizontal integration."

Three largest NA companies have the most to lose from idle capacity

The three largest North American companies, Blue Bird, MCI and Nova BUS, are the most integrated and have the largest investment in plants and automated equipment. They have the most to lose from idle capacity and the greatest incentive to gain and expand market share. In the face of anticipated slow demand and continuing industry overcapacity, these companies can be expected to bid aggressively on price for forthcoming contracts.

Smaller, more specialized firms respond more flexibly to specialized needs

The smaller, more specialized competitors, New Flyer, Orion and Volvo-Prévost, are less integrated and automated and have smaller facilities, and therefore less overhead to absorb. An ability to respond flexibly to smaller orders and specialized needs may offer some competitive advantage.

Orion is particularly well positioned for specialization. After beginning solely as a bus refurbisher, Orion's forte emerged in heavy-duty, small transit buses, i.e., 21-, 25-, 30- and 35-foot lengths (6.4, 7.6, 9.1 and 10.6 metres). However, the firm also produces the standard 40-foot (12.2 metres) bus as well. Numerous products branded Orion are manufactured in various lengths and contain special features. For example, some buses are adapted for the handicapped, and others for ambulance service or sightseeing.

Electric trolley buses are powered by overhead electric lines and are the most notable example of specialization for New Flyer, the only volume manufacturer of such buses in North America. The company believes that there will be potential demand emanating from various transit authorities on the U.S. west coast. Additionally, New Flyer is the only North American company with a fully tested and certified low-floor bus at the present time, a concept that has swept European bus technology, and is fast gaining popularity here. Nova BUS has recently developed a low-floor bus of its own design and the company expects that this model will sell very well in Canada and the U.S.

3 CHANGING CONDITIONS AND INDUSTRY RESPONSE

3.1 Investment and Financing

Canadian manufacturing investment is restricted by U.S. purchasing limits

Transit buses are purchased by municipal and regional transit authorities in Canada and the United States. These public entities rely almost entirely on government funding to make their purchases. U.S. content specifications for urban transit buses such as the "Buy America" regulations require a Canadian urban bus manufacturer to have both a Canadian assembly and a U.S. final assembly plant to meet the 60 percent U.S. content requirements. Hence, only partial assembly is possible in Canada, and Canadian urban bus manufacturers incur additional costs through a second assembly plant in the U.S. and incremental transportation charges.

American purchasing restrictions regarding urban transit buses effectively restrict Canadian investment in manufacturing. These restrictions also affect the American bus manufacturing industry, limiting potentially beneficial joint product development, free access to the larger combined Canadian and U.S. market competition, and rationalization of excess capacity and inefficient manufacturing.

Intercity Coach Manufacturing

Strategies include . . .

Volvo-Prévost has recently reinvested in its existing plant facilities and is streamlining its assembly line. The company is in the process of moving parts production out of its assembly plant, thereby increasing production capacity and decreasing costs. Historically, it has made a significant volume of its own parts and components and has a major investment in its machine shop.

outsourcing . . .

Outsourcing future parts production by Volvo-Prévost will result in new business opportunities for parts suppliers and will strengthen this industry in Quebec. Suppliers in turn will likely move from parts manufacturing to system assembly. Outsourcing parts production will also transfer manufacturing technology from the bus assembler to parts manufacturers.

Urban Transit Bus Manufacturing

corporate restructuring . . .

In Quebec, Nova BUS has invested over $20 million in its Saint-Eustache plant and on R&D for new bus models. In December 1994, it acquired the TMC heavy-duty bus manufacturing assembly facilities in Roswell, New Mexico, and Schenectady, New York. Bombardier has agreed to purchase 100 percent of Nova BUS shares, allowing it to supply the full range of urban passenger systems, and enabling Nova BUS to assemble the financing to bid on major contracts. Turning to Ontario, Orion Bus Industries (OBI) has been purchased by Western Star from the Province of Ontario. The firm is continuing the applied research program and will be producing the old OBI models and the new low-floor bus. Manitoba producer New Flyer has constructed a new final assembly plant in Crookston, Minnesota.

School Bus Manufacturing

Most standard school buses are produced in Canada by the Canadian subsidiaries of two major U.S. corporations: Blue Bird and Thomas Built. A. Girardin and Les Entreprises Michel Corbeil mainly produce school minibuses, vehicles for the transport of the physically disabled and some school buses in standard sizes only.

and seeking reinvestment

School bus manufacturing is a stable to declining industry; therefore, there is some reinvestment in existing facilities but not much in new facilities. Since the current plant layouts and production processes are often inefficient, they need to be updated and improved. Consequently, there is a real need for reinvestment by the companies in their existing assembly facilities.

3.2 Trade

Under the FTA, tariffs on original products, including parts and vehicles, are being phased out in 10 equal, annual steps ending in 1998. By then, all Canada–U.S. automotive trade will be governed by the FTA, which will guarantee continued access to the U.S. market, as well as providing a dispute settlement mechanism lacking in the Auto Pact. The Auto Pact and its penalties will remain in place, should a company fail to meet requirements.

Original product tariffs end in 1998

The NAFTA, in turn, retains the FTA and Auto Pact provisions and extends them to Mexico. Under the NAFTA, Canadian urban transit producers retain preferential access to U.S. markets and gain access to Mexico. Mexico is modernizing its transportation infrastructure and privatizing some state-run operations, which may present new opportunities for Canadian bus makers.

NAFTA gives Canada access to Mexican opportunities

Prior to the implementation of the NAFTA in 1994, Mexican tariffs on urban transit and rail products were in the range of 10–20 percent. Over half were eliminated on January 1, 1994, including those on diesel engines, most axles and wheels and their parts, coupling devices and parts, as well as signalling equipment and parts. Most remaining Mexican tariffs will be eliminated in 10 annual stages ending January 1, 2003. Canadian firms are having no difficulty in adjusting to the new trade environment insofar as tariff barriers are concerned, and welcome the onset of freer trade across North America.

Mexican tariffs end in 2003

While the NAFTA confirmed existing Canadian access to the U.S. market, non-tariff measures continue to restrict market access and discourage investment or expansion in Canada. "Buy America" provisions restrict U.S. market access and discourage investment or expansion in Canada. U.S. regulations also limit the use of Canadian parts and component suppliers.

"Buy America" provisions restrict U.S. market access

The 1978 U.S. *Surface Transportation Assistance Act* required transit authorities receiving U.S. federal funding to purchase on the basis of U.S. final assembly and a U.S. content level, waivable only under certain stringent conditions. Amendments made in 1987 to the U.S. *Surface Transportation and Uniform Relocation Assistance Act* tightened "Buy America" provisions, raising the content requirement from 50 percent to 60 percent. In addition, U.S. procurement legislation and practices have commonly set aside many procurement contracts for U.S. small businesses, frequently defined as up to 1500 employees, and for minority-owned companies.

Historically, all provinces provided guidelines for preferential purchasing of local or Canadian content. Of all provinces, Quebec had the highest provincial content requirements, at 45 percent. This has been reduced to around 20 percent at the present time.

Recent federal-provincial internal trade negotiations, concluded in July 1994, have considerably reduced preferential purchasing in Canada. However, some provincial governments still have retained vestiges of their own procurement requirements for urban buses.

Local preference procurement policies close European and Japanese markets . . .

Tariffs are not a major factor in trade between Canada and other developed countries. However, local preference procurement policies and standards or specifications of special requirements impede Canadian exports significantly. These barriers, together with strong indigenous industrial capacity, have virtually closed European and Japanese markets to Canadian producers.

as do product design preferences and standards

Product design and performance standards act as effective barriers to trade, or at least increase the cost of market entry. In bilateral trade, standards may work to the advantage of one country and the disadvantage of the other. However, standards are largely harmonized in the North American automotive sector; therefore Canadian bus manufacturers continue to enjoy an advantage over foreign producers in the U.S. market.

3.3 Human Resources

The need to increase productivity and utilize advanced materials will place higher demands on the assembly plant work force and foster the development of new skills for the workers in all subsectors. Flexible manufacturing and team manufacturing will require training and the acquisition of new skills. The upgrading of skills will result in workers familiar with electronic control, advanced materials, quality control concerns, etc. This skill training will require a well-planned and coordinated effort.

To meet technological and productivity challenges, skills upgrading is required

3.4 Technological Change

Intercity coaches have a long life due to their robust design and construction. Because of demands for continuous improvement by customers, however, intercity coach manufacturers have tended to undertake continuous R&D in recent years. R&D expenditures by intercity coach manufacturers in Canada on average have been consistent at approximately 1 percent of net sales.

Intercity bus customers demand improvements, pushing continuous R&D effort

R&D expenditures by intercity coach builders increased during the mid-1980s, from less than $1 million spent by the Canadian industry, until 1990, when average annual expenditures of over $2 million per year were incurred. This growth in R&D expenditure is expected to continue as products are further refined and new products are investigated.

In fact, both MCI and Volvo-Prévost continue to develop new proprietary products and evolve their proprietary process technology. In particular, Volvo-Prévost has very strong R&D capability.

Urban Transit Buses

Slow turnover and replacement reduce the need for continuous R&D in urban transit buses

Urban transit buses have a product design life cycle in the neighbourhood of 15 years. New product development does not occur on an annual basis as in the automotive industry. Nevertheless, innovative bus designs continue to be produced by all three Canadian companies in this sector. They lead the continent or the world in some specialized areas such as use of alternate fuels and fuel cell technology, and buses for the physically disabled.

New bus designs incorporate innovative component technologies and composite materials. Canadian urban bus manufacturers are also increasingly focussing on improving product quality and lowering production costs. Reduced federal and provincial funding, local matching funds, general economic conditions, ridership declines, etc. have all combined to increase the average life in use of individual fleets beyond the nominal life expectancy of 15 years. The average operating life is being extended by transportation authorities, and is currently estimated to be 19 years.

The first NA low-floor bus was introduced in Canada

Until the introduction of a semi-low-floor bus by New Flyer in 1992, urban transit bus manufacturers had not introduced a strongly differentiated product in the standard 40-foot (12.2 metres) bus line for more than 20 years. The transition from high-floor (two or three steps up to floor height) to low-floor buses, where the floor is virtually at curb level, has been the most significant recent change in the urban bus market.

Because Den Oudsten BV, owner of New Flyer, was one of the European leaders in low-floor bus development, New Flyer was able to introduce the new low-floor buses to North America. Low-floor buses are now required by provincial funding regulations in Ontario and Alberta. This is perhaps the most significant development in urban transit bus design. Neoplan and Nova BUS have developed low-floor buses, segmenting the large transit bus market into two distinct segments: high-floor and low-floor.

School Buses

Canadian school bus manufacturers design and build only a small percentage of their chassis requirements. They rely totally on suppliers for innovation of major components.

School bus plant layout and production processes are often inefficient and need to be updated. Companies need to reinvest in their existing assembly facilities. More efficient production processes would lower assembly costs.

A better and cheaper school bus model is required with a longer life cycle and alternate fuel drivetrain. A new industry entrant or an existing company with such a model could create a substantial market niche.

Demand for better school buses offers a possible market niche

Although few parts and components producers supply school bus manufacturers, the potential exists for these to become system suppliers. If assembly plants are streamlined and production increases, some in-house parts production will be outsourced, leading to the probable expansion of existing suppliers. The need for alternate fuel drivetrains is expected to bring in new suppliers to the subsector.

3.5 Sustainable Development

There are significant pressures on the bus industry across North America to reduce pollution from vehicles, even though they are substantial pollution savers compared with automobiles. Although the technology exists for clean-fuel buses, there is a significant incremental cost for an alternate fuel engine or a diesel engine with particulate traps. Other technologies can be even more expensive.

Bus industry faces pressure to reduce pollution

The "greening" of the transportation system in general and the public transportation system in particular is not a simple matter of imposing regulations. The introduction of clean advanced manufacturing processes will be a continuous effort. New products will need to become "greener" in the drive for zero emissions by public transportation systems, and new systems technologies must prove to be both effective and affordable. New product technologies have been developed and could contribute substantially to the quest for zero emissions.

Alternate fuel engines could push bus cost up by $50 000

Efforts to switch to alternate fuel buses to reduce emissions could increase the cost of a bus by US$50 000. However, environmental benefits from a switch to alternate fuel technology are questionable because tailpipe emissions may not be better than "clean" diesel engines of the present and future. The incremental cost and higher maintenance requirements may not be justified, since significantly lower pollution levels may not be realized.

3.6 Government Policies

Government policies and regulations have had both positive and negative effects on this industry. Although the Auto Pact eliminated tariffs, U.S. preferential buying policies have increased manufacturing costs.

A major aspect of the FTA provided current Canadian bus producers with a cost advantage over potential new entrants. New manufacturers are at a considerable disadvantage, since the Auto Pact states that no additional companies producing vehicles in Canada may qualify as eligible manufacturers under provisions similar to those in the Auto Pact for the purpose of qualifying for duty-free status.

The passage of the U.S. *Americans with Disabilities Act* in 1990 accelerated the design of low-floor vehicles to facilitate access to those with disabilities. Other innovations were the introduction of electronic signage, lifts and the use of new materials. In most cases, these changes raised manufacturing costs and therefore purchase prices.

Content specifications for urban transit buses have made it necessary for Canadian urban bus manufacturers to have both Canadian and U.S. final assembly plants to meet the 60-percent U.S. origin content requirements. Canadian urban bus manufacturers incur additional costs through a second assembly plant in the U.S. and incremental transportation charges. In addition, governments also provide various forms of direct and indirect financial assistance to bus manufacturers, thereby affecting competitiveness in the North American market.

4 GROWTH PROSPECTS

4.1 Demand Outlook

Demand for most types of urban transit and school buses is flat or declining

Canada's bus making sector is affected by several North American market trends likely to remain significant in the near future. These include declining ridership, production overcapacity, aging population, privatization, life cycle costing, new government regulations and decreasing government funding; all contribute to a reduced demand for new urban transit and standard school buses. However, each major sector will feel the impact differently. While there may be a few world market niches for specialty vehicles, offshore exports do not appear to be a major short-term option.

Demand for intercity buses is shrinking . . .

In the immediate future, intercity bus manufacturers face slow market growth, largely because of the decline of Greyhound, which was MCI's major customer. The Canadian market is also expected to grow very little. There is expected to be a continuing shift in demand from current 40-foot (12.2 metres) standard to 45-foot (13.7 metres) long intercity coaches.

Driving forces behind this change are the removal of restrictions by most U.S. states on bus length, increased revenues from operating a larger-capacity coach, and new production models with improved wheelbases capable of being driven on narrow city streets.

while demand for urban transit buses is static . . .

The market for new urban transit buses is likely to be static. Transit authorities will attempt to reduce purchase and maintenance costs. Currently, all three Canadian companies are at full capacity. The North American market is expected to level off or even decline somewhat. Though U.S. federal funding programs are declining, municipalities need to replace older fleets of transit buses to comply with new clean air legislation. Alternate fuel engines are being considered by the industry, and almost all new transit buses will need to operate on cleaner fuels by 1999. Engine manufacturers are increasingly capable of supplying either alternate fuel or "clean" diesel engines.

. . . and demand for school buses is depressed

The school bus market in North America currently is depressed. This subsector normally has a strong replacement potential, but bus operating life continues to be extended as school districts and fleet operators respond to government and local budget reductions. The school bus segment could become the slowest-growing market of the three in the near future.

Demographic changes may help demand for intercity buses

Long-term growth in the intercity bus market will depend on increased tourist travel generally, increased travel by older age groups and more luxurious coach interiors. Population trend changes such as aging and increasing disposable income might result in increased intercity tour bus demand.

The market for urban transit buses could change if U.S. government funding that regulates when city and regional transit authorities are permitted to buy new buses is extended to an 18-year cycle rather than the current 12-year cycle. Consequently, the long-term market is expected to be smaller for new buses. The market for parts and components for in-service models is expected to increase. Companies offering the longest warranties will pick up market share.

Demand for low-floor urban transit buses is expected to be strong

Low-floor urban bus sales are expected to increase dramatically for all producers. These are now at 30 percent of all purchases, but are expected to be at 80 percent in two to three years. The remaining 20 percent will be filled by heavy-duty buses. Privatization of transit authorities will change the bidding process, shifting from the current emphasis on purchase cost to a new emphasis on life cycle cost and acquisition financing.

A niche market entry opportunity exists in the urban transit market for manufacturers who can make smaller buses holding 20 to 30 passengers with the same economy of operation as larger units. Aside from new assembly opportunities, assemblers could create an entirely new service industry by establishing bus service centres in downtown locations as well as providing extended manufacturers' warranties to transit authorities.

Longer life of school buses, demographics and reduced educational spending contribute to refurbishing trend

Markets for standard school buses are expected to decline because of the longer life of school buses. A shortage of funds by the school boards may result in possible privatization of the school board transportation services, the introduction of user fees or the leasing of the fleet. Refurbishing old school buses after their normal life of seven to 10 years has become an export opportunity. As school boards receive funding for new buses after seven to 10 years of service, old buses are taken out of service, and these could be exported to developing countries.

Among school-age children, populations in different age groups will vary, thus making overall long-term demand a flat or only modest growth prospect. Moreover, declines in school board funding and the privatization of school boards may make use of other forms of transportation than school buses appear more cost effective. Other institutional users of school buses may increase their demand modestly over the long term.

4.2 Key Industry Strengths

Intercity Buses

Canada's producers of intercity buses remain strong

The large combined market share enjoyed by the two Canadian companies, the introduction of advanced models, excellent parts distribution and service systems, and Canadian-based engineering design capability auger well for the future of this subsector. The purchase of Prévost by Volvo in June 1995 will have a dramatic impact on North American intercity coach production. As a result, Volvo obtains North American market share, a well-developed distribution network, Auto Pact access and credit. Volvo-Prévost is profitable and will continue to invest in new models.

Both Volvo-Prévost and MCI have world-class engineering design capability, and all of their North American vehicle product engineering is done in Canada. Both companies are profitable. Both also have excellent parts distribution systems and strategically located service centres throughout North America. Only MCI has a U.S.-based final assembly plant, which enables it to sell to U.S. government agencies and to supply other federally funded purchase requests. MCI also has the largest market share of any intercity bus producer in North America.

Urban Transit Buses

Low-floor buses give Canadian urban bus firms an edge in a competitive market

Nova, Orion and New Flyer all have very good engineering design capability and have recently designed low-floor bus models. They are improving their parts and service distribution systems.

Nova arguably has the most advanced low-floor bus model in North America and has up to 60 percent of the U.S. market for all urban bus models. It is aggressively competitive, offering the longest warranty in the business (10 to 12 years) and has a novel approach to service as well as extended warranties to reduce the costs of fleet operators. It is also examining new financing methods such as lease-back arrangements, lease-to-own, etc.

With the first new design, New Flyer has the highest number of low-floor buses in the market. Its electric trolley bus and articulated low-floor bus are unique products. The company is opening a new final assembly facility in Minnesota and will benefit from the superior economies of a new, more efficient plant.

With its improved product range, Orion has about 20 percent of the urban transit buses in service and has the Ontario municipality transit bus sourcing contract. It is also building a new, more efficient manufacturing plant in Oakville, Ontario.

School Buses

Strong U.S. parent companies support two major Canadian school bus manufacturers

All companies have an established parts and sales distribution network. Financially, the parent corporations of the two U.S. companies, Blue Bird and Thomas Built, are very strong. Blue Bird has a diversified product line and is the largest school bus manufacturer in North America. The Blue Bird plant in Brantford, Ontario, produces both conventional buses for Canada and the northern U.S., and minibuses for the region west of the Mississippi River. Thomas Built is the second largest school bus manufacturer in North America. Its Woodstock, Ontario, plant builds only conventional full-sized and small school bus bodies; most body components are brought in from the parent assembly plant in the U.S.

A. Girardin builds school minibuses. For Blue Bird, it manufactures a single rear-wheel model on a Ford chassis, the Micro-Bird II, for sale in the U.S. Les Entreprises Michel Corbeil Inc. manufactures standard school buses, school minibuses and vehicles for the transport of the physically disabled. The strength of the two Canadian manufacturers, A. Girardin and Les Entreprises Michel Corbeil Inc., which are much smaller, is not clear.

4.3 Current and Anticipated Challenges

Intercity Buses

Canadian intercity bus firms must maintain current market share

The main challenge for Canadian manufacturers is to maintain current market share, avoiding potential loss to offshore producers, and further erosion of the overall intercity bus market. Volvo-Prévost has no U.S.-based final assembly plant, and therefore potential clients must forgo U.S. government purchaser subsidies. MCI suffers doubly by first losing its exclusive supply relationship with Greyhound, the dominant fleet operator, and then again from Greyhound's declining market. MCI will now be competing against Volvo-Prévost and European manufacturers. It could also be sideswiped by financial losses for Dina, its parent, due to the weak Mexican economy. This may force Dina to sell MCI's profitable parts distribution system.

Urban Transit Buses

Production overcapacity is a major problem. Municipal and regional transit authorities are frequently managing a shrinking budget, thus often delaying new bus purchases. Canadian urban bus manufacturers alone could readily produce more than double the entire North American market demand. Manufacturing plants are in need of further rationalization but, if lean production processes are introduced, they would become even more efficient, which would only worsen the overcapacity problem. New rules and regulations in the past several years are forcing manufacturers to design and engineer new products and adjust existing systems.

Excess capacity exists in NA urban transit bus production

All three Canadian-based companies could be affected by increased "Buy America" requirements, decreased U.S. federal funding support, increased environmental abatement requirements and an increased life span requirement in the U.S. from its current 12 years to 18 years, as in Canada.

School Buses

In a number of urban centres, school boards are issuing bus passes for students to use the urban transit system instead of being transported by school buses. Refurbishing used transit buses will also reduce the demand for new school buses. Tele-schooling may become a reality and further reduce demand. The safety of school buses remains an issue. Some manufacturing facilities are old and inefficient. In a declining market, there is a requirement to rationalize production and improve efficiency. Only one of the two smaller companies is associated with a major school bus manufacturer.

4.4 Future Opportunities

Intercity Buses

The intercity bus market is relatively stable. Volvo-Prévost might reduce overhead cost further by applying Volvo manufacturing process technology. The company may benefit from consolidating some operations with Volvo's truck

Intercity bus firms look to reducing overhead and entering the Latin American market

manufacturing facilities in North America. Volvo-Prévost could also reduce costs by using Volvo components where these are cost effective, adapting proven Volvo designs and increasing capacity utilization by entering urban transit bus manufacturing. For MCI, Mexican and South American market opportunities have opened up. MCI's new model is about to enter the market and, if accepted, increased market share could result, probably at the expense of European transplant assembly operations.

Urban Transit Buses

New bus designs have an effect on the supply industry

New transit bus models have led to the adoption of new production methods and design technology by the supply industry. New bus designs will require new parts and components suppliers. The potential also exists for company acquisitions and for new investment in urban bus assembly, along with assembly plant consolidation and improvement. New manufacturing methods are required to produce the low-floor bus. At Nova BUS, the entire bus body is rotated for manufacturing ease and worker injury reduction. The potential also exists for licensing innovative product design and process technologies.

Two of the three urban transit manufacturers, Nova and Orion, could lever advantages from the greater financial, technical and marketing resources of their corporate owners, for example, through the purchase of major systems at lower prices, possible joint venture opportunities, and product design assistance and integration of technology from other industry segments.

Bus manufacturers consider the possibilities of leasing

All three bus manufacturers might be able to support marketing strategies by accommodating the transit authorities with a leasing facility option instead of selling them, if there is an increasing rate of privatization of transit authorities. Further value might be offered by possibly taking over their maintenance needs. New Flyer also has a niche market opportunity: it has manufactured a number of buses for the Ballard fuel cell demonstrations (Annex F contains more information regarding technological change in bus manufacturing).

School Buses

A major opportunity exists to improve the product design and durability of school buses. Future school bus designs will have to include advanced materials for lighter, safer and more durable body structures. Further rationalization of production and the improvement of manufacturing processes will contribute to the viability of this subsector.

Future school buses will be lighter, safer, longer-lasting

4.5 The Bottom Line

Bus manufacturing is reasonably profitable and the current market is relatively stable. Increasing price competition among intercity bus producers indicates a need to reduce production costs while increasing bus quality and customer satisfaction. Some companies may not survive another economic downturn unless their parent corporations have substantial financial strength.

The bus sector is profitable but pressured by cost and increasing competition

Substantial manufacturing overcapacity remains. There is also a need to reduce production costs and improve bus quality to reduce overall life cycle costing. In Canada, the interprovincial barriers to bus purchases need to be lowered further. One bus manufacturer could disappear through a corporate acquisition, such as a foreign takeover, or through further consolidation in the North American industry.

Assembly plant jobs are expected to decline as a result of productivity improvements and major system outsourcing. However, more jobs are expected in the independent supply sector, as manufacturers continue to streamline procurement and outsource some parts making and subassembly processes. If American non-tariff barriers increase, all Canadian manufacturers, in particular urban bus makers, will experience a significant job decline.

Manufacturers offer few new jobs, but outsourcing creates some supplier jobs

In the short term, bus assemblers are reinvesting in existing plant facilities, simplifying manufacturing by focussing on final assembly and moving parts production out of their assembly plants, reallocating floor space for building more vehicles and decreasing their overall costs. Outsourcing parts will result

Firms are optimizing their assembly facilities

in additional business for parts suppliers and strengthen them. The number of bus manufacturing plants is expected to remain the same in Canada.

A major round of bus model innovation is under way

In both intercity and urban transit subsectors, innovation is high. Volvo-Prévost, MCI and Nova BUS all have new bus models. In the long term, niche potential exists for making smaller tour and shuttle buses. Higher use of weight-reducing composite material in intercity and urban buses will increase fuel efficiency and decrease operating costs.

Canadian producers continue to lead in specialized areas such as use of alternate fuels, innovative fuel cell technology and buses for the physically disabled. As well as new bus technologies and composite materials, Canadian urban bus manufacturers are focussing greater R&D efforts on improving quality and lowering production costs. No new technology is on the horizon for school buses, although a redesigned bus with new materials and alternate fuel technology would meet market demand.

These issues will be addressed in a forthcoming *Framework for Action*, to be developed after extensive consultations with industry stakeholders. Industry Canada hopes that this *Overview and Prospects* will provide a solid basis for jointly discussing and planning resolutions.

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Annex A
MAJOR NORTH AMERICAN BUS MANUFACTURERS: CAPACITY AND PRODUCTS

Company	Corporate Headquarters	Nominal Capacity (units)	Products
Urban Transit Buses			
Nova BUS Saint-Eustache, Quebec	Canada	1 200	Conventional, low-floor transit buses
Nova BUS–TMC Roswell, New Mexico	Canada	1 200	Conventional, heavy-duty transit (RTS) buses
The Flxible Corporation Delaware, Ohio	United States	1 200	Conventional transit buses
Neoplan USA Corporation Lamar, Colorado	United States	850	Low-floor and articulated buses
New Flyer Industries Ltd. Winnipeg, Manitoba	Canada	600	Conventional, articulated, low-floor and electric trolley buses
Orion Bus Industries Ltd. Mississauga, Ontario	Canada	1 400	Conventional, low-floor, articulated and special-use buses
Gillig Corporation Hayward, California	United States	450	Conventional and special-use buses
Ikarus USA, Inc. Anniston, Alabama	Hungary	300	Conventional and articulated buses
Estimated total capacity		7 100	
Intercity Coaches			
Motor Coach Industries (MCI) Winnipeg, Manitoba	Mexico	1 000	Conventional motor coaches
Neoplan USA Corporation Lamar, Colorado	United States	N/A	Specialty motor coaches
Volvo-Prévost Car Inc. Sainte-Claire, Quebec	Canada (Sweden)	500	Conventional and articulated motor coaches
Eagle Coach Corporation Brownsville, Texas	United States	500	Conventional motor coaches
Estimated total capacity		2 000	

Company	Corporate Headquarters	Nominal Capacity (units)	Products
School Buses			
Thomas Built Buses Inc. High Point, North Carolina	United States	7 500	School buses, motor coaches and minibuses
Blue Bird Body Company Fort Valley, Georgia	United States	10 000	School buses and minibuses
Estimated total capacity		17 500	

Annex B
MANUFACTURER RELATIONSHIPS WITH CUSTOMERS

Intercity Motor Coaches

Intercity motor coach buyers are generally private operators of line-haul, charter and tour bus operations. In the U.S., such operators have a more open regulatory environment than in Canada. Over 100 companies provide various types of charter service and, in both countries, the intercity scheduled bus services are dominated by Greyhound Lines with 2300 buses in operation.

Other intercity scheduled bus services and charter companies are considerably smaller and highly dispersed geographically. The average large motor coach fleet has 220 buses, and purchases are generally made in small lots. The fleet operator is primarily concerned with the durability and dependability of the coaches. New bus purchases by fleet operators have been few in number because of deregulation and the impact of substitute modes of travel. The profitability of line-haul operations throughout North America is lower and has therefore resulted in heightened cost concerns among operators. This has lowered the demand for coaches and has stabilized prices.

Tour operators are usually small, some with as few as a single bus. This industry also is highly fragmented and widely dispersed geographically. European motor coach designs are characterized by luxurious and comfortable interiors that pamper the customers. North American tour operators have preferred to purchase European designed buses at the expense of North American bus producers. These producers have provided largely undifferentiated buses to both the line-haul operators and the tour operators. North American buses are not well suited to the tour market.

As a result, potential sales have been lost to European producers such as LAG, Kässbohrer, Van Hool, Neoplan and others. Tour operators have also found European producers very willing to provide further customization and interior amenities. There clearly are further growth prospects in this growing market segment, and North American manufacturers are responding to this potential. In an increasingly deregulated environment coupled with relative ease of entry and low start-up costs, especially in the U.S., new tour operators have substantially expanded the market for tour buses. Nonetheless, European producers retain their competitive edge not only because of the distinctive styling and luxurious interiors but also because of enhanced after-sales service of their coaches.

Buyers of intercity motor coaches, who are mainly intercity scheduled bus services, charter and tour operators and transit authorities, are frequently able to specify those major components that determine bus performance, and they are very price sensitive. Therefore, bus manufacturers have little scope for differentiating their products. Most bus sales involve intense price competition, with only some differentiation on ease of repair, corrosion resistance, manufacturer's warranty and spare parts.

Urban Transit Buses

Transit buses are purchased by municipal and regional transit authorities in Canada and United States. These rely almost entirely on government funding for their purchases. Given this reliance, their major concern is the cost of the bus and its performance. They often specify both key performance components and the low-bid contracting process. Hence, the manufacturer undertakes specialized production for each contract at the expense of standardization so as to reduce costs. The entrance of foreign producers and the increasing availability of extra production capacity have contributed to a highly competitive market situation. Although bus operators generally service and maintain their own fleets, this practice may change with the availability of extended manufacturers' warranties.

Conventional transit buses are standardized with a 40-foot (12.2 metres) length, a 27 000-pound (12.3 tonnes) curb weight and 125-gallon (468 litres) gas tanks. Some additional standardization has occurred among major components and is currently being driven by the regulatory environment. There appears to be further potential to standardize parts and components to reduce the cost of manufacturing, both within the firm and industry-wide.

School Buses

School buses are sold directly to school boards and private transportation contractors. School districts are estimated to own 61 percent of school buses in North America, while 33 percent are owned by private contractors that serve the school districts. Private schools are estimated to own the remaining 6 percent of the fleet. Both standardization of product and product development has occurred in this industry segment. For example, in 1980, school bus bodies were classified into four categories by the National Minimum Standards Conference on School Transportation in the U.S. In addition, the U.S. National Standards for School Buses and Operations require uniformity in the design of school bus electrical systems and in the layout of accessory control panels. Such uniformity benefits both operators and manufacturers, and simplifies the production process.

Although chassis production has been dominated by Navistar and Ford, some of the body manufacturers are taking control of the chassis design process and are having these built to their specifications. School bus manufacturers are also adapting to changing market conditions by producing new and redesigned models, mainly driven by safety concerns. Most new models are intended to meet the growing demand for transit-style Type D buses, which have a flat-nosed, cab-over design. Other new features are forward-control, transit style models and flat-floor buses. The conventional-style Type C school bus, however, continues to outsell Type D buses.

The replacement demand for school buses resulting from the implementation of many safety regulations has contributed to a modest increase in sales. In the U.S., vehicles older than 12 years are decertified for the transportation of school children.

Shrinking school transportation budgets in particular are reducing the demand for new school buses as school boards try to extend the life of a bus. Nonetheless, there is a steady replacement demand for an aging school bus fleet, and this remains the core requirement. School bus customers need to replace their aging fleets, even though their budgets are being reduced. Product development is occurring in this highly price-sensitive market segment because of new regulations.

Annex C
MANUFACTURER RELATIONSHIPS WITH COMPONENT SUPPLIERS

Major proprietary systems product suppliers have a high degree of economic power over bus assemblers, since the supplying industry is highly concentrated. Major system suppliers are typically much larger than their bus manufacturing clients, and their sales to these manufacturers represent only a small proportion of their total sales. The high-volume scale of components production and the degree of manufacturing specialization preclude rearward integration by the bus manufacturer. Also, the customers frequently specify the major components to ensure a high-performance product. This reduces the negotiating power of the manufacturer.

The critical issue in the manufacturer–supplier relationship is the proportion of parts purchased for assembly by the manufacturer, the size of the supplier group and the small number of firms producing any one component or part. The chassis, including the engine, transmission, axles and brakes, characteristically adds up to about 50 percent of the production cost of the bus. Typically this leaves the tasks of metal forming, frame manufacturing, constructing the shell from metal or plastic and final assembly to a Canadian manufacturer, if the bus is marketed in Canada. Thus, the quality of the parts and components purchased by the manufacturer and the price paid for these components are of critical importance to the manufacturer's competitiveness.

Characteristics of Suppliers

The parts and components supply industry is more diverse than the bus manufacturing industry in terms of the number of products produced and the number of participating firms. In comparison with the automotive industry, bus manufacturers require only low volumes of parts and components. Suppliers to the bus industry have a relatively high degree of product specialization and cannot afford to become dependent on supplying bus manufacturers exclusively.

Groups of firms involved in supplying parts and components may be broadly categorized into three groups: specialized subsidiaries of large corporations, which produce major components; specialty producers, whose products have less value-added and less sophistication; and bus manufacturer subsidiaries, which are oriented more toward parts production. For example, major component suppliers, often subsidiaries of large corporations such as Allison, Eaton, Rockwell, ZF and Carrier, and such major engine producers as Detroit Diesel and Cummins, are specialized in high-value-added component manufacturing. However, optimal bus performance lies in the more complex purchased components, for example, the transmission and the engine. There are also groups of smaller, specialty producers who produce smaller component assemblies such as seats, lighting modules and signage specifically for the bus manufacturers.

A number of bus manufacturers, in particular MCI and Flxible, manufacture parts and have established separate subsidiaries to supply both original equipment and after-sales markets. European bus manufacturers have imported major components and have contributed to the establishment of European component manufacturers in North America.

Manufacturers: Price versus Security of Supply

In most cases, the bus manufacturers do not themselves produce major components, although they are sometimes produced by an affiliated company. Bus manufacturers must purchase a large portion of their components from suppliers. The bus purchaser often specifies the major components and therefore the manufacturer must trade off between maintaining a secure supplier network and bargaining intensely on price for some of the minor components.

In addition, the bus parts aftermarket has provided little opportunity for the independent supplier industry. This segment of the supplier industry is dominated by the subsidiaries of the two largest manufacturers: MCI and Flxible Corporation. Universal Coach, owned by MCI, and Flxible's parts subsidiary are the major aftermarket suppliers, but Neoplan also supplies the aftermarket

with parts for their buses. Bus refurbishing, on the other hand, can and has been a profitable area for many suppliers, as bus operators look for any means to maintain productive fleets in a business climate of reduced funding and intense competition.

Lack of Product Standards

When GM was the leading bus manufacturer, it introduced many innovative features in design and construction in the industry, and dominated bus assembly and major component manufacturing. However, little in the way of standardization of specifications occurred, even though a major effort was undertaken by the U.S. Urban Mass Transit Administration (UMTA) to fund the production of a more standardized bus. This has had a number of ramifications for manufacturers, especially those that are less vertically integrated. For example, the manufacturer needs to work more closely with suppliers to fund the design, development and testing of major bus alterations.

Lack of product standardization and the potentially high degree of special features does not play a significant role in preventing purchasers from switching to another manufacturer. To the operator, a basic bus is like any other and is designed to move as many people as possible at the lowest cost. Therefore, costs of special features must be borne to a certain extent by the bus manufacturer. To meet such needs the manufacturer will frequently have to deal very closely with a supplier. This may in turn lead to heavy dependence by the manufacturer on a specific component supplier.

Suppliers of either major bus components or parts are few in number. Bus operators and purchasers often specify major components to guarantee high performance, durability and low maintenance. Also, since the demand for components is for low volumes only, suppliers need to diversify into other industries to reduce their reliance on bus manufacturing. In addition, standardization in the final product has been slow to emerge. The development costs for any major product alterations must be borne by the bus manufacturer, which result in higher product costs.

Annex D
REGULATORY REGIME FOR DIFFERENT TYPES OF BUSES IN NORTH AMERICA

Intercity Bus Regulation

In Canada, the responsibility for issuing operating authorities, reviewing fare levels and reviewing proposed changes for intercity bus service within provinces is delegated to provincial regulatory agencies.

Canadian companies offering scheduled intercity bus service operate in a regulated environment, which limits participation in the industry to licensed operators. These have a limited monopoly of services in a designated area in return for certain commitments, for example, serving remote areas or routes with little traffic, as well as regulation of prices.

Carriers offering a public transportation service are required to have a public vehicle licence and they need to adhere to numerous other regulations, including those governing the characteristics of vehicles. These requirements have kept the number of operators low, and this may have the effect of restricting manufacturers' sales. In Canada, the major effect of regulation on bus manufacturing is that scheduled intercity bus lines have found it desirable to overinvest in coaches, which has resulted in underutilization of buses.

The U.S. federal government plays a major role in intercity bus transportation in two distinct ways. The first deals with participation, for example, through control of entry and exit, routes and other certificate restrictions, rate control, and quality of service standards, which are often regulated by independent regulatory commissions. The second way is through legislated standards, for example, energy use or environmental impact and safety.

Urban Transit Bus Regulation

Transit services, like all public services, receive substantial government financial assistance. Part of this assistance covers gaps between revenues and expenses, because transit is considered a necessary public service. Transit systems must therefore operate unprofitable routes or at off-peak hours. Numerous U.S. federal regulations and U.S. court decisions require the provision of services for the aged and disabled. Most of these are operated as expensive, demand-response services. In addition, the regulations require reduced fares for the aged and disabled during off-peak transportation service periods.

Additional regulations regarding low-polluting bus engines, safety features, etc. have added to the cost of transit service vehicles and have increased operating practices.

There is very little direct federal regulation of U.S. urban transit services. Transit regulation is under the jurisdiction of state and local government. The U.S. federal government exerts influence through conditions attached to federal financial assistance.

Non-economic regulation by the U.S. federal government is considerably more pervasive than economic regulation in this market. Most of these regulations are requirements attached to federal assistance programs.

In 1964, the U.S. Congress determined that the welfare and vitality of urban areas was being jeopardized by the deterioration or inadequate provision of urban transportation facilities and services. To remedy this situation, Congress enacted the *Federal Transit Act*, know as the *Urban Mass Transportation Act* (UMTA) of 1964, which, until 1991, provided financial assistance for transit systems to purchase capital equipment; this capital assistance usually consisted of 80 percent federal and 20 percent state and local funds. The practice has since been discontinued.

Because the largest share of the cost of a bus in the U.S. was subsidized, fleet redundancy grew at minimal cost to the operator. UMTA guidelines established a 20-percent differential between active and maximum vehicle requirements, and the increasing useful lifetimes of the buses have resulted in a large increase in the number of buses owned by transit authorities.

Public Transportation Accessibility

The *Americans with Disabilities Act* (ADA) was signed by the U.S. President on July 26, 1990. This provides disabled Americans with accessible public transportation. The legislation includes a section detailing requirements that a bus manufacturer must fulfil for new vehicles to meet ADA specifications.

Local transit authorities have started implementing major changes to their vehicles and services in an attempt to comply with ADA regulations. The following are the basic requirements for:

- low-floor buses, all vehicles will need to provide a level change mechanism or boarding device, for example, a lift or ramp, and sufficient clearances to permit a wheelchair or other mobility aid user to reach a securement location
- signage, every vehicle must display easily readable, illuminated route signs both on the front of the vehicle and on the boarding side
- communication, public transit vehicles longer than 22 feet (6.7 metres) used in multiple-stop, fixed-route service must be equipped with a public address system.

These regulatory requirements have significantly affected bus manufacturing in North America. They have increased the cost of a typical bus and have proven costly to implement by the transit authorities, which have encountered difficulty in financing the needed changes to their services.

Annex E
THE BUS MANUFACTURING PROCESS

Bus manufacturing is essentially an assembly operation, sourcing the bulk of its major components from the North American medium and heavy truck sectors. Few components are specifically designed for buses. In general, most technologies reach the bus industry from truck and aerospace manufacturing. Production techniques are chiefly manual and feature small-volume, almost batch processing, although substantial progress is being made in improving bus manufacturing processes.

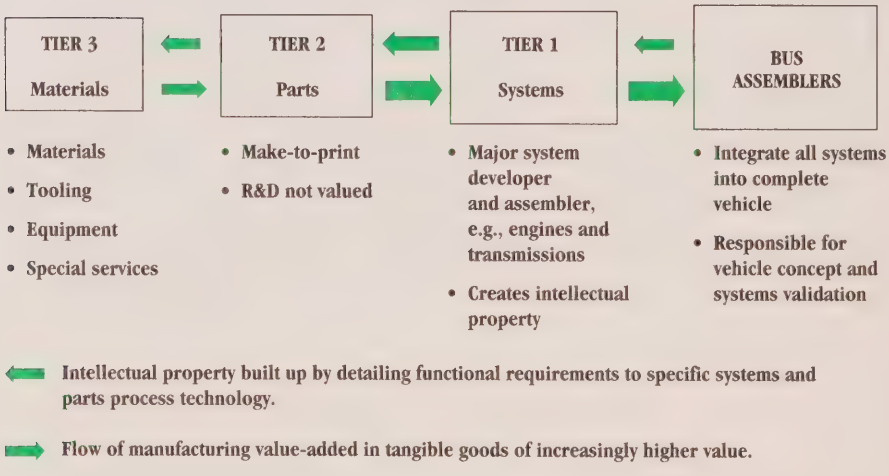
Major systems such as chassis parts, engines, transmissions, steering, axles and brakes can represent up to 50 percent of the cost of a bus, and are purchased from independent suppliers located mainly in the United States. Proprietary engineering product design by the bus manufacturer figures prominently only in the shape of the bus, its frame, door systems and interior furnishings. The requisite technology for these product design changes is rarely developed by the bus manufacturers themselves, however; instead, it is most often purchased from other industry sectors. Such other components as seats, lights, doors, signage, heaters and air conditioning are also purchased from outside suppliers.

Most bus manufacturers have little control over these major cost components, since they are purchased from major suppliers of proprietary systems products. The economies of large-scale component manufacturing preclude their small-volume production by bus manufacturers. However, most major bus manufacturers except school bus producers design and manufacture their own chassis and, most importantly, the frame and bus shell. These are their major proprietary areas, where they evolve product design and process technologies.

Manufacturers have traditionally maintained strict cost-control procedures and, until the early 1980s, there was very little product differentiation in the urban transit bus category. New regulations, rising costs and some market penetration by European producers have resulted in new bus designs and increased competition. In general, bus manufacturers in North America have encountered little foreign competition because of different technical requirements for intercity buses and local content rules for urban transit bus manufacturing.

In the value-added chain of production in the large bus sector (Figure E-1), Tier 3 producers are mainly material suppliers, but also include tooling, equipment and special service suppliers. Tier 2 companies are parts manufacturers that produce according to blueprints provided to them by the owner of the proprietary rights to the parts, which could be either the Tier 1 full-service systems supplier or the bus assembler itself. Tier 2 producers have very little intellectual property or original engineering design in these parts; their R&D is not valued and therefore is not paid for in the piece price. Tier 1 producers are typically major system developers and have the proprietary rights to these systems. Bus assemblers integrate all systems into complete vehicles. They are responsible for vehicle concept, systems validation and management and integration of the supply chain.

Figure E-1. Functional Structure of the Large Bus Sector



Annex F
TECHNOLOGICAL CHANGE IN BUS MANUFACTURING

Low-floor Buses

In 1983, Ontario Bus Industries Ltd. (now, Orion) designed and produced North America's first low-floor design, the Orion II minibus. A low-floor configuration is made possible by having a front-wheel drive with independent rear-suspension chassis, while a kneeling capability combined with a ramp allows wheelchair boarding. The Orion VI model features the engine and transmission mounted at an angle in the left rear corner, and the development of drop centre axles with an offset differential allows the floor to be virtually at curb level.

New Flyer Industries has developed the "user friendly" TUF model; a full-sized, low-floor bus using a conventional engine and transmission mountings and rear axles. Another feature of the TUF model is a steel ramp that eliminates the need for a wheelchair lift.

The low-floor design by Nova BUS is called the Low Floor Series (LFS). It is equipped to meet ADA regulations with a kneeling capability and will also be compatible for use with alternate fuels.

New Construction Materials

Because of their lighter weight, better corrosion resistance and lower construction costs, new materials are being explored by the industry. In the U.S., aerospace engineers are teaming up with transit professionals to probe materials for the bus body such as composites of glass epoxy, closely woven glass fibres and carbon fibres, and for a stainless steel body frame with exterior panelling of a resin-bonded glass and aramid fibre composite with compressed foam.

Alternate Fuel Technology

The U.S. bus manufacturing industry has recently had to respond to new regulations, including those under the U.S. *Clean Air Act* amendments of 1990. The latter will probably mean the demise of the proven but dirty two-stroke diesel engine, to be replaced by a much cleaner four-stroke engine. Detroit Diesel, a major supplier to Canadian bus manufacturers, now supplies four-stroke, four-cylinder engines.

Compressed natural gas (CNG) and liquefied natural gas (LNG) are possible replacements for diesel. Both can be used in engines based on existing diesel designs and can reduce emissions. However, CNG requires new fuelling stations and heavy fuel tanks mounted on the roof of the bus. Refuelling time is increased substantially. It has yet to be determined whether the added expense will result in significantly lower regional pollution levels.

Experiments to reduce pollution using devices and fuel additives continue with varying degrees of success. Particulate traps have proved effective in reducing some forms of emissions. Despite these advances, it is unclear whether these devices will enable the four-stroke diesel engine to meet required 1998 U.S. Environmental Protection Agency emissions.

Alternate fuels seem to be gaining widespread use. The American Public Transit Association recently reported that, for 1994, 8.2 percent of U.S. buses are powered by alternate fuels, up from 5.9 percent in 1993. There is also renewed interest in electric-powered transit buses. Orion has developed a three-axle vehicle, using a generator and wheel-mounted electric motor instead of a conventional transmission.

While battery-powered buses have been a long-sought goal, battery weight, limited range and low speed make such vehicles impractical for any use other than as circulators or in specialized applications.

Ballard Power Systems Inc., with funding support from the Government of British Columbia, Natural Resources Canada/CANMET and BC Transit, has demonstrated that a transit bus powered by proton exchange membrane (PEM) fuel cells can provide the same or better performance than the diesel equivalent. A fuel cell converts hydrogen directly into electricity. The only by-products are water and some heat. The current test vehicle is a National Coach Corporation Model Re-32 bus. This is a 32-foot (9.8 metres), 22 000-pound (10 tonnes) GVW chassis and is configured with transit seating to accommodate 20 passengers. The next test vehicle, a full-sized, 40-foot (12.2 metres), heavy-duty transit bus chassis produced by New Flyer, is expected to have a range of 250 miles (400 kilometres) through the use of improved hydrogen storage. Passenger capacity will be increased to 60 with smaller and lighter second-generation 10 kilowatt fuel cell stacks.

The electric trolley bus is one way to reach the goal of zero emissions, but in only a few cities does it appear to have any real future. It continues to be useful where its lack of flexibility and relatively high cost are overridden by its zero emissions, in areas where power is cheap, like the West Coast, or where its superior hill-climbing ability is useful.

Design teams developing the "next-generation bus" are exploring the possibility of using four electrical motors, one to drive each wheel, whose power is supplied to a continuous-running, natural-gas engine acting as a generator, or possibly a flywheel electricity-storage technology. One major drawback of this technology is that flywheels, as they are currently designed, are extremely expensive, thus ruling out their use anytime soon.

Articulated Buses and Other Configurations

The articulated bus with its greater capacity has proved useful on routes with heavy traffic, but some operators have experienced increased loading times at stops where large numbers of riders board.

Proof-of-purchase fare systems, use of passes or payment of fare upon exiting on outbound trips are partial solutions. Articulated buses have worked well in providing base service on the exclusive and dedicated busways at Pittsburgh and Ottawa.

Intelligent Transportation System

The Intelligent Transportation System (ITS) operates through an onboard computer that helps bus drivers maintain their schedules, gives passengers more reliability and enhances their maintenance capabilities. The computer is linked to a vehicle area data network to improve overall operating performance of the fleet. Passengers benefit from more reliable route schedules and more timely and comprehensive information on the buses. Operators benefit from continuous information on route schedules. Maintenance schedules are more readily available, making it possible to arrange mechanical repairs overnight.

Annex G
MAJOR BUS CATEGORIES: TYPE, LENGTH, CLASS AND DISTINGUISHING FEATURES

Bus	Bus Type	Length/Class	Distinguishing Features
Intercity	Conventional	40' (12.2 m) – main type 45' (13.7 m)	For high speed, long-distance travel purpose; front doors only; rest room facilities and storage compartments.
	Articulated model HF 60; includes large-capacity, articulated coaches and double-decker coaches	60' (18.3 m); most fall under Class 8; width: 92–102 in. (2.3–2.6 m) (82% are of the longer type)	
Transit	Conventional	35'; includes 36'–39' (10.7–11.9 m) 40'; includes 41'–49' (12.2–14.9 m)	Integral vehicle, in which the working parts are attached directly to the vehicle.
	Articulated		
	Electric trolley buses		
School (handicapped or special-purpose designs)	Type A	GVW: 10 000 pounds (4.5 tonnes) or less	Conversions or bodies constructed upon van-type buses, compact trucks or front-section vehicles; usually carry 16–24 passengers.
	Type B (handicapped or special-purpose designs)	GVW: more than 10 000 pounds (4.5 tonnes)	Conversions or bodies constructed and installed upon van or front-section vehicle chassis or stripped chassis; used for small groups and shorter routes; could include special-purpose items; can carry up to 38 passengers.
	Type C	GVW: 18 000–28 000 pounds (8.2–12.7 tonnes)	The engine is in front of the windshield; long nose conventional type; can carry 24–84 passengers.
	Type D	GVW: 26 000–32 900 pounds (11.8–15 tonnes)	The engine could be behind the windshield, rear wheels or between the front and rear axles; flat-nosed design can carry 78–90 passengers.
Mid-sized and small buses	Mid-sized	27'–34' (8.2–10.4 m)	Applications: transit, handicapped, airport car rental, and hotel/resort shuttle.
	Small	27' (8.2 m) and under	

Source: Planned Business Reports, *The Bus Market in North America: 1992–97 Analysis, Evaluation and Forecast*, 1992.